SSP 50323

Payload User Development Guide (PUDG) For the Space Station Training Facility (SSTF) Payload Training Capability (PTC)

International Space Station Program

August 29, 2001

Revision A

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas
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PAYLOAD USER DEVELOPMENT GUIDE (PUDG)

FOR THE

SPACE STATION TRAINING FACILITY (SSTF)

PAYLOAD TRAINING CAPABILITY (PTC)

CONTRACT NO. NAS9-18181, SCHEDULE C

29 August 2001

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National Aeronautics and Space Administration
Advanced Operations and Development Division
and the Space Flight Training Division
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1. INTRODUCTION

1.1 Identification

This Payload User Development Guide (PUDG) for the Space Station Training Facility (SSTF) Payload Training Capability (PTC), SSP-50323, provides information applicable to all organizations responsible for International Space Station (ISS) payloads. It describes the SSTF and PTC services and resources that support payload operations training and provides information and interface definitions needed to develop a Payload Training Simulator (PTS) to be integrated into the SSTF and interface with the SSTF Full-Task Trainer (FTT). PTS classifications are defined in Section 4.1. If a PTS is not Class IIb or IIIb, some of the interfaces defined in the PUDG may not apply. Some information in the PUDG, such as sections related to Logistics, Handling, Safety, and Security, applies to all items brought into the SSTF facility. The PUDG also defines Payload Resource Utilization (PRU) data required to be provided for all U.S.-sponsored pressurized and attached payloads so that SSTF models of ISS systems can account for payload resource consumption. The SSTF is located at the National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) in Houston, Texas.

1.2 Purpose

The purpose of the PUDG is to provide detailed information on the SSTF PTC design, services, resources, and capabilities and to specify the interfaces, procedures, and constraints that must be complied with to develop PTSs that are compatible with SSTF PTC interfaces and services and which can be integrated into the SSTF. The PUDG also provides information required to bring other items into the SSTF facility to support payload training in the SSTF.

The PUDG defines roles and responsibilities of organizations involved with PTS development, integration, interface, test, verification, acceptance, training, and maintenance. One group of organizations assigned responsibilities includes the sponsoring NASA Payload Development Center (PDC), the Payload Element Developer (PED), and possibly other support groups and contractors. In this document, these organizations are collectively known as the Payload Developer (PD), with roles and responsibilities as defined in Section 3.1. Section 3.2 defines roles and responsibilities for other organizations that support payload operations training at the SSTF. Those roles and responsibilities are divided among the NASA Payload Operations Integration Function (POIF) managed by the NASA Marshall Space Flight Center (MSFC) (including POIF Simulation Engineering), and NASA JSC. The roles and responsibilities are presented in the typical order in which they are provided to support payload operations training. Some responsibilities may be transitioned to other organizations during the lifespan of a PTS in the SSTF. Plans for delegation of specific responsibilities for a PTS may be documented by the Training Strategy Team (TST) or POIF personnel.

1.3 Document Overview

This document includes the following sections and appendixes:

a. Section 1 specifies the identification, purpose, document overview, and ground rules of the PUDG.

b. Section 2 identifies reference documents used in the development of this document.

c. Section 3 identifies SSTF and PD roles and responsibilities with respect to PTS development, integration and interface test and verification, acceptance, training, and maintenance.

d. Section 4 provides detailed overviews of the SSTF components that are available to support PDs.

e. Section 5 defines the contents of payload training delivery packages.

f. Section 6 provides a list of acronyms and a glossary of terms.

g. Appendix I, PTC Facilities and Procedures, describes the payload training facilities and the processes and procedures the PD will need to understand to work in the SSTF and PTC environments.

h. Appendix II, SSTF PTC Instructor/Operator Station (IOS) Display Development Process, describes the procedures followed to design and implement IOS displays that monitor and control an integrated PTS.

i. Appendix III, SSTF-to-PTS Interface Specification, specifies the interfaces between the SSTF and PTSs and the limitations with which PTSs must comply.

j. Appendix IV, Payload Training Support Items (PTSIs), provides information about PTSIs made available through the NASA JSC SSTF Project Office for use by organizations that are developing an integrated PTS for use in the SSTF.

k. Appendix V, Payload Simulator Environment (PSE) and Simulator Text Fixture (STFx) Specifications, establishes the as-built design, manufacture, performance, and test criteria for the PSE/STFx product.

1.4 Ground Rules

The specific training requirements for each payload are determined by a payload-specific TST, chaired by POIF personnel. If the TST determines that a PTS is required in the SSTF, general requirements for it are defined in SSP-58026, Generic Payload Simulator Requirements Document (PSRD), Volume I. The PSRD was written by POIF Simulation Engineering and has appendixes to address the various payload simulator types.

The Generic PSRD Volume I and the appropriate appendix, in conjunction with the PUDG, will provide the PD with the requirements and information to build a PTS to be integrated into and interface with the SSTF PTC. The Generic PSRD also provides requirements for other classes of nonintegrated trainers to be physically located within the SSTF facility. For each required facility class, integrated PTS, POIF Simulation Engineering shall also write a payload-specific PSRD Volume II that defines payload-specific data and display parameters and PTS checkout procedures.

If a payload-specific TST approves specifications for a PTS that does not satisfy all requirements of the PSRD or PUDG or that requires additional SSTF support, the TST shall submit a waiver request to the NASA JSC SSTF Project Office for the areas of noncompliance. The SSTF Project Office will determine the effect of the waiver, identify a Rough Order of Magnitude (ROM) cost for any resulting SSTF change or special handling requirements, and determine whether to accept the waiver request and associated costs or to require compliance with the PSRD and PUDG.

In all cases, whether a PTS is or is not required in the SSTF, the resource usage by all U.S.-sponsored pressurized and attached payloads must be identified so that the SSTF can implement a PRU model on the SSTF host to account for payload resource consumption when no integrated PTS is active. Information about the PRU model and data that must be supplied to allow it to be defined is included in Section 4.9 and in Appendix III. If the TST determines that a PTS is not required, POIF Simulation Engineers will provide the data required for the PRU to the SSTF.

If a Class IIb or Class IIIb integrated PTS is required for a payload, it shall be based on a PSE with a configuration baselined by the NASA Payloads Control Board (PCB) unless a waiver is requested and approved. The PSE is a low-cost Personal Computer (PC)-based simulation environment that supports rapid development of simulation models and includes the Payload Simulation Network (PSimNet) and Command and Data Handling (C&DH) interfaces required for a PTS to be integrated into the SSTF. A PSE can be obtained as specified in Appendix IV. For more information about developing an integrated rack-level PTS using a PSE, refer to Section 3.1.1, Appendix IV, Appendix V, and SST-646, Payload Simulator Environment (PSE) and Simulator Test Fixture (STFx) User’s Guide for the Training Systems Contract.

Each rack used for an integrated PTS shall be an SSTF-provided International Standard Payload Rack (ISPR) or a PD-provided rack that complies with the interfaces, limits, specifications, and handling provisions as specified in Appendix I, Appendix III, and Appendix IV. Electrical and data interfaces between an integrated PTS and an SSTF training facility are provided by two complementary interface panels, the Standoff-Mounted Interface Panel (SIP) and the ISPR-Mounted Interface Panel (IIP), and a set of umbilical cables to connect the IIP to the SIP. The SIP includes a mixture of simulated and functional connectors corresponding to the connectors on ISS Utility Interface Panels. It includes a connector for 208/120 VAC power for use by the PTS. The SIP provides the only connections available for an integrated PTS to the simulated C&DH system and to SSTF core system simulations via the PSimNet. All integrated PTSs shall include an IIP properly wired to provide the required interfaces to the SSTF unless a waiver is requested and approved. An SSTF ISPR, IIP, and Fire Detection System/Maintenance Switch (FDS/MAINT) panel can be obtained as specified in Appendix IV.

1.5 Contact Information

Initial contact with the SSTF at JSC and requests for information on payload-related topics should be made by electronic mail to

PSE_SSTF@jsc.nasa.gov

Information related to ISS payloads, including points of contact, for the POIF at MSFC can be obtained on the Internet at http://payloads.msfc.nasa.gov/station/

2. APPLICABLE DOCUMENTS

The following documents of the exact issue shown are an applicable part of this document to the extent specified herein. Subtier documents referenced in the cited documents are not applicable unless referenced within this document. In the event of conflict between the documents referenced herein and the content of this document, this document shall be considered a superseding document.

D683-35455-1, User's Guide for the Suitcase Test Environment for Payloads (STEP), Revision A, 15 July 1998

EIA-RS-170, Electrical Performance Standards for Monochrome Television Studio Facilities, 11 November 1957

IEEE-STD-802.3-2000, Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, 16 October 2000

JPG-2810.1, Johnson Space Center Information Technology (I/T) Security Handbook, Revision A, 01 October 2000

JSC-36265, Space Station Training Facility to Johnson Space Center Operational Communications Interface Control Document, Revision A, 14 November 1997

MIL-STD-1553B, Interface Standard for Digital Time Division, Command/Response Multiplex Data Bus, Revision B, 21 September 1978 (updates to Notice 4, 15 January 1996)

PTS User's Guide (to be published separately for each PTS)

RFC-894, Standard for the Transmission of IP Datagrams over Ethernet Networks, C. Hornig, 01 April 1984

SSP-58026, Generic Payload Simulator Requirements Document, Volume I, 04 January 2000

SSP-58309, Payload Training Implementation Plan, 08 December 1999

SST-204, Volume 1, Integrated Training Facility (ITF) Human-Computer Interface (HCI) Style Guide and Standards, 16 May 1995

SST-204, Volume 2, ITF Full-Task Trainer (FTT) Instructor/Operator Station (IOS) Display Programming Rules for Real-Time Sammi Displays, Revision 1.1, 01 August 1996

SST-635, Level A Requirements for the Space Station Training Facility, 13 February 1998

SST-646, Payload Simulator Environment (PSE) and Simulator Test Fixture (STFx) User's Guide for the Training Systems Contract, 31 March 2000

TCP/IP Illustrated: The Protocols, Volume 1, W. Richard Stevens, Ninth Printing, Addison-Wesley Publishing Co., Reading, MA, 1996 (© 1994)

3. ROLES AND RESPONSIBILITIES

This section defines the roles and responsibilities of the PD and other organizations at the SSTF in support of the flight crew and JSC and MSFC Ground Support Personnel (GSP) training on payload operations. It applies to payloads for which the TST has determined that a PTS will be required to be integrated into the SSTF and interface with the SSTF FTT. SSTF and PTC support roles include those of NASA JSC and the POIF, including Simulation Engineers. Specific responsibilities related to providing PTSs and other training material will be determined by the TST.

3.1 Payload Developer Roles and Responsibilities

The following sections define the PD roles and responsibilities in support of payload operations training at the SSTF. The PD is responsible for developing a complete payload training delivery package, as defined by the TST and documented in the PSRD, to be delivered to the SSTF. Mandatory and negotiable items to be included in payload training delivery packages are listed in Section 5. The roles and responsibilities are presented in the typical order in which they are performed in the most general case. The SSTF shall be provided with a current list of contacts related to PD responsibilities while the PTS is in the SSTF. Some responsibilities may be transitioned to other organizations during the lifespan of a PTS in the SSTF. Plans for delegation of specific responsibilities for a PTS shall be documented by the TST or POIF personnel.

3.1.1 Integrated PTS Development

If the TST determines that an integrated PTS is required, the PD is responsible for designing, procuring or developing, testing, and integrating hardware and software into a system that conforms to the interfaces, limitations, and restrictions specified in Section 4, in Appendix I, and in Appendix III.

All Class IIb and Class IIIb PTSs are required to be based on a PSE platform unless a waiver is requested and approved (refer to Section 1.4). The PSE is a low-cost PC-based simulation environment with provisions for rapid development of simulation models and includes the simulated C&DH and PSimNet interfaces. The PSE includes development tools such as G2 (a Commercial Off-the-Shelf (COTS) expert system development environment that uses graphic representation and structured English rule bases) to aid the PDs in developing a model of their system or payload. A PSE can be obtained as specified in Appendix IV.

For integrated PTS development, the PSE computer will be provided as a combined PSE and STFx system. The STFx software includes the SSTF side of the PSimNet interface and limited fidelity models of SSTF core systems. It has an interface to control operation of a Suitcase Test Environment for Payloads (STEP), which provides C&DH interfaces. It includes user displays to send control commands via the PSimNet to an integrated PTS and provides a capability to execute predefined test scripts to send commands via the PSimNet or to the STEP. The STFx function will be available to a PD to assist in integrated PTS development.

The PD will be required to operate an integrated PTS to verify to POIF Simulation Engineering that the PTS meets performance requirements, including host interfaces and simulated payload malfunctions, prior to shipment of the PTS to the SSTF.

For more information about the PSE and STFx, refer to Appendix IV, Appendix V, and SST-646. For more information about the STEP, refer to D683-35455-1, User's Guide for the Suitcase Test Environment for Payloads (STEP).

All integrated PTSs shall incorporate interfaces to the SSTF core systems as specified in Appendix III, Section 30.3.3.1, and to simulated ISS onboard equipment as specified in Appendix III, Section 30.3.3.2, including generation of simulated payload health and status data. The fidelity of the simulated health and status data content will be determined by the TST. The TST may also identify a subset of the simulated health and status data to be periodically put into PSimNet messages to be made available for display at an IOS or STFx.

All integrated PTSs shall include software to support operations sufficient to provide training for GSP at the Payload Operations Integration Center (POIC) without requiring any actions to be taken from a PTS operator panel unless a waiver is requested and approved (refer to Section 1.4). Data values shall be defined for transfer via the PSimNet to allow interaction at an IOS to initialize, monitor, and change data values as required. This capability shall allow installation and use of the PTS software in a PSE that does not have any Signal Conversion Equipment (SCE) or additional hardware. For more information about the POIC training capability, refer to Section 4.15.

PD responsibilities for providing support for developing STFx displays for use in a Standalone Payload Training Capability (SPTC) configuration will be defined in Volume II of the PSRD for the PTS. For more information about the SPTC, refer to Section 4.16.

The PD for an integrated PTS is responsible for identifying the following data using the PSimNet Message Layouts defined in Appendix III, Section 30.6:

a. Any health and status data or other data to be made available for display at an IOS or an STFx

b. Any simulator-unique data required to be displayed or changed at an IOS or STFx for monitoring or control of the PTS

c. Data to be transferred via the PSimNet to support IOS displays to allow monitor and control of the PTS without interaction at a PTS operator panel

The PD is responsible for providing documentation of PTS hardware and software to support SSTF personnel in the PTS integration, verification, and test processes as defined in Section 3.2.8. The PD shall provide source code for all software written to implement an integrated PTS and shall identify all COTS products used in their PTS so that the software can be replicated and modified for use in software-only payload simulators at the SSTF. The PD shall also identify a point of contact to provide technical assistance and/or to aid in problem resolution during activities involving the PTS within the SSTF.

3.1.2 PTS System Integration

The PD is responsible for providing an integrated PTS that can be used in an SPTC session as described in Section 4.16 and can be efficiently installed into and interfaced with the SSTF. This section (3.1.2) provides ground rules that apply to PTS integration. Any deviations from the ground rules shall be negotiated in the payload-specific TST and documented in the PTS User's Guide.

The International Space Station Program (ISSP) has defined a group of facility class payloads, each of which is installed in one or more ISS flight ISPRs or EXPRESS racks. Additionally, some complex or long-duration Laboratory Support Equipment (LSE) payloads have been identified that will be treated as facility class payloads for purposes of training in the SSTF. If the TST determines that an integrated PTS is required for a payload, it is expected to be integrated into the same number of racks as the flight payload. The integrated PTS will have access to a SIP at each crew station element rack location. The Alternating Current (AC) power connection at each SIP can be used as needed. The simulated connections at all SIPs are available for use to simulate flight payload connections. If the flight payload connects to the C&DH bus with more than one remote terminal or Payload Ethernet Hub Gateway (PEHG) interface, the PTS shall support the same number of interfaces. However, to allow proper mode control of the PTS, each integrated PTS computer shall interface to the SSTF PSimNet through only one SIP.

Each rack used for an integrated PTS shall be an SSTF ISPR (refer to Appendix IV, Section 40.3.2) or a PD-provided rack that complies with the interfaces, limits, specifications, and handling provisions as specified in Appendix I, Appendix III, and Appendix IV. The PD can request the required number of SSTF ISPRs as Government-Furnished Equipment (GFE) as specified in Appendix IV, Section 40.4.1, or they can provide their own compliant racks. In either case, the PD is expected to install and integrate the PTS into the rack(s) prior to shipment to the SSTF. If any PTS equipment is not installed in SSTF ISPRs or compliant racks prior to shipment, the PD is responsible for installation and integration of the equipment at the SSTF. The detailed procedures for rack integration will be documented in the PTS User's Guide.

All integrated PTSs shall include an IIP properly wired as specified in Appendix IV, Section 40.3.4, to provide the required interfaces to the SSTF unless a waiver is requested and approved (refer to Section 1.4). The IIP shall either include an SSTF-provided FDS/MAINT panel as described in Appendix IV, Section 40.3.5, or the PD shall provide equipment that will present the same electrical interface at the IIP.

Each integrated PTS shall be contained within the volume of the rack(s) it occupies, plus any TST-approved extensions into the crew station corresponding to extensions of the ISS flight payload being simulated. An extension outside the rack volume is permitted so long as it does not extend beyond the largest projection of the ISPR in any direction. If training requires equipment to be extended from the front of the rack or attached to a seat track, rotational forces placed on the rack shall be limited as specified in Appendix III, Section 30.4.3.1. No simulator-unique extensions or attached devices such as an instructor keyboard can be used outside the ISPR for PTS maintenance or control during a training session. At other times, activities that require attached devices or temporary placement of components outside the normal volume of the rack(s) will be restricted due to floorspace limitations, safety requirements for clear paths to emergency exits, etc. Maintenance access to an integrated PTS while it is installed in a crew station element is restricted to the front or rear of the rack. Tilting of the rack is not allowed. If access to the sides or top of a rack is required, it must be moved from its normal position in the crew station element.

EXPRESS racks and some other facility class payloads include capabilities to support multiple experiments within a single rack. The SSTF PTC baseline includes support for one integrated PTS for each EXPRESS rack or similar facility class payload. The SSTF will provide one SIP at each rack location. If multiple simulators are required for the same rack, the PD for the facility class payload is responsible for providing intrarack distribution of power and distribution and collection of simulation data. The PSimNet message layouts defined in Appendix III, Section 30.6, provide sufficient data variables and malfunctions so that subsets of each can be allocated to subrack payloads to make subrack simulator variables available for display at an IOS or STFx and to allow IOS or STFx interaction with subrack simulators. Details shall be specified in Volume II of the PSRD for the facility class payload PTS.

All PTSs and procedures for installation and component movement shall comply with limitations and handling procedures as specified in Appendix I, Sections 10.4 and 10.5. Total resource usage for a complete integrated PTS rack shall comply with limits defined in Appendix III.

The SSTF PTC baseline includes support for integrated PTSs only for rack-level payloads installed in ISS module rack locations designated for U.S.-sponsored payloads. The SSTF PTC does not presently have provisions for supporting simulation of attached payloads or for simulation of LSE not treated as a facility class payload. Payload resource utilization data will be required for all U.S.-sponsored payloads that use ISS power, cooling, nitrogen, vacuum, or waste gas exhaust, including attached payloads and LSE, to account for their resource usage. If it is determined that PRU data is needed, POIF Simulation Engineers will provide the required data to the SSTF.

The PD is responsible for demonstrating correct interface operation of the PTS to POIF personnel. Interface testing will be performed using a STEP for testing C&DH interfaces and the STFx for controlling the STEP and testing the PSimNet interface. A set of test scripts will be provided with the STFx and is expected to be executed successfully before the PTS is shipped to the SSTF. For technical information about the STFx, refer to SST-646, which can be obtained as indicated in Appendix IV, Section 40.3.6.

The PD shall provide documentation of test procedures and test results to the SSTF for use in interface verification testing at the SSTF as described in Section 3.2.9.

3.1.2.1 PTS Implementation Data

The PD shall provide the following data relative to an integrated PTS implementation to support integration of the PTS into the SSTF and use of the PTS in SPTC sessions:

a. Zip disk containing all PSE software, including source code

b. Diskette (3.5 inches) containing STEP configuration data

1. PTS MDM data configuration file /usr1/step/stepgui/userdata

2. PTS timeliner script file /usr1/step/timeliner/script

3. PTS ground database file /usr1/step/timeliner/GDB

c. Information on PTS implementation

1. PTS name

2. Computer administrator name and password

3. Name of top-level G2 module (default user-api.kb)

4. Identification of any user external program called by c:process/ff.exe

5. Information about use of SCE and definition of any modifications to sce.exe

6. Health and status data collection rate and size

7. Low-rate telemetry data collection rate

8. Broadcast ancillary data rate and frame

9. Unique ancillary data set number and rate

10. File transfer information

11. Payload commands

12. PEHG configuration

13. Bundle information

3.1.3 IOS Display Development Support

The PD for an integrated PTS is responsible for supporting the development of displays for the IOSs as specified in Appendix II. Activities during the PTS development timeframe include the following:

a. Provide information about payload experiment operational objectives and instructor displays used by the PD and participate in reviews of the material provided.

b. Support the definition of IOS displays required for integrated PTS operation in the SSTF.

c. Ensure that support for the IOS displays is included in the design of PTS models and controls.

d. Provide information required and support identification of PTS parameters supporting IOS displays so that the parameters can be specified in Volume II of the PSRD.

e. Participate in technical interface exchanges as development of the PTS and IOS display formats continues to ensure agreement between them. This is expected to be an iterative process.

Note that information about display formats can be provided by the PD using a method of their choice. PD personnel are not required to learn to use the SSTF display definition tool.

3.1.4 Configuration Management

The PD is responsible for Configuration Management (CM) of the PTS and other training material prior to delivery to the SSTF. The PD shall ensure that the correct hardware and software versions of a PTS are delivered to the SSTF for use in payload operations training at the SSTF. The PD is responsible for performing CM at the SSTF for their PTS hardware and software and all other training material they provide. Procedures for CM of PTSIs used in a PTS are given in Appendix IV, Section 40.4.3.

3.1.5 Training Material Packing and Shipment

The PD has primary responsibility for packing and shipping all PTSs and other payload training items to the SSTF at NASA JSC. After the payload training delivery package arrives at JSC, the SSTF and other organizations will have specific roles and responsibilities as listed in Section 3.2. Additional information about procedures related to receiving and handling training items is given in Appendix I, Sections 10.4 and 10.5. If a PTS or other training material is already at JSC, the PD shall contact the SSTF as specified in Section 1.5 to coordinate movement to the SSTF.

The PD is responsible for contacting the SSTF as specified in Section 1.5 at least 6 months prior to the planned shipping date so that shipping arrangements can be coordinated, the proper information can be provided to the PD by SSTF personnel, and the PD can be informed about information they shall provide to the SSTF.

If a PTS is installed in an SSTF ISPR, it shall be shipped in a GFE Rack Shipping Container (RSC). Refer to Appendix IV, Section 40.3.3.3.3, for a description of the RSC. For PTSs not shipped in an RSC and for all other training material, the PD is responsible for providing durable shipping containers to protect the contents. Containers and packing materials shall be compatible with the handling procedures and limitations specified in Appendix I, Sections 10.4 and 10.5. The PD is responsible for securely packing all PTS hardware and other items in the shipping containers to prevent damage during shipment.

The PD is responsible for identifying all items included in the payload training delivery package and for itemizing them on a shipping invoice. Consumable items shall be so identified. The shipping invoice will be used to identify items brought into the SSTF and will be used as a reference when training for the payload is complete and payload training items are being removed from the SSTF. Inventory descriptions shall include item number or part number, description, bar-coded property identification tag number (government or PD-assigned, as applicable), quantity, any proprietary indications, and total replacement cost per shipping container. Refer to Section 5 for a list of mandatory and negotiable items to be included in the shipment.

The PD is responsible for clearly labeling the outside of the shipping containers with gross weight, lift points, and any special moving or handling instructions. All such labels shall be in the English language and securely fastened to the shipping containers. Refer to Appendix I, Section 10.5.

The PD is responsible for attaching proper address labels to the shipping container. To ensure that information is correct, the PD shall obtain current shipping labels from the SSTF. Labels shall be similar to the following, but may have different information.

CRITICAL ITEM National Aeronautics and Space Administration Lyndon B. Johnson Space Center Houston, Texas 77058 ATTN: SSTF Onsite Payload Coordinator SSTF, Building 5 South Phone (281) 483-9135, Pager (713) 788-3983 DO NOT OFFLOAD AT RECEIVING (Bldg 421)

The PD is responsible for making arrangements with commercial carriers for shipment of their payload training delivery package containing PTS hardware and other training material to the SSTF.

3.1.6 Unpacking

The PD is expected to have a representative present when unpacking occurs and is responsible for ensuring that the PTS and other training material is unpacked properly. The PD is responsible for noting any damage during shipping and reporting it to the carrier. If so directed by the PD, SSTF personnel will provide assistance as specified in Appendix I, Section 10.4.3.

3.1.7 Integration Support

3.1.7.1 PTS Integration Into the SSTF

The PD is responsible for providing a PTS ready for integration into the SSTF and for supporting the integration. The PD is responsible for providing payload-unique command and data definitions to the Payload Software Integration and Verification Facility (PSIV/F) for creation of an early release of flight products suitable for use in the SSTF to accommodate PTS integration and training. Specific responsibilities, in addition to those listed in this section, are specified by the TST.

Currently, all integrated PTSs are expected to simulate a payload installed in one or more ISS flight ISPRs. If all PTS equipment is not integrated into the SSTF ISPRs or compatible racks prior to shipment to the SSTF, the PD has primary responsibility for installation and integration of the equipment at the SSTF. The detailed arrangements for rack integration will be documented in the PTS User's Guide.

If a PTS is not to be installed into an SSTF ISPR, it is expected to be self-contained when it arrives at the SSTF and to include an IIP properly wired to interface with the SSTF. The PD will have responsibility for preparing it for connection to the SSTF. The PD shall comply with the handling procedures and limitations in Appendix I, Sections 10.4 and 10.5. Detailed arrangements will be documented in the PTS User's Guide.

While SSTF personnel have primary responsibility for performing the physical integration of PTS hardware into the SSTF and the interface test and verification of PTS hardware and software, the PD is responsible for supporting those tasks.

The PD has primary responsibility for resolution of any PTS discrepancies found during delivery, inspection, installation, integration, verification, and testing. Development of discrepancy corrective actions may take place at the SSTF or at the PD facility, depending on the extent of modifications required. Discrepancy resolution may include the following:

a. Modifications to or replacement of PTS hardware

b. Modifications to PTS software

c. Modifications to PTS courseware

d. Modifications to PTS documentation

e. Furnishing new baselines

If a Trouble Report (TR) was entered in the SSTF CM system for a discrepancy later determined to be in the PTS, PD personnel shall take action to resolve the discrepancy as indicated above and provide information about the corrective action to SSTF personnel so that the TR can be closed.

3.1.7.2 IOS Display Integration Support

The PD is responsible for supporting the integration of IOS displays with an integrated PTS as specified in Appendix II. Activities during the integration timeframe include the following:

a. After the PTS has been installed in the SSTF, participate in the use of the IOS displays to activate and operate the PTS to verify that the IOS displays can be used to control the PTS as part of the SSTF string.

b. When the PTS has been verified to operate as part of the SSTF string, participate in the verification of the IOS displays used during the training process.

c. Participate in the analysis of problems identified during IOS display testing to help determine the problem source.

d. If problems found during IOS display testing are determined to be caused by discrepancies in the PTS, take corrective action. In any case, participate in retesting the IOS displays.

3.1.8 PTS Maintenance and Operations Support

The PD has responsibility for providing or otherwise arranging for Maintenance and Operations (M&O) support for their PTS hardware and software after it is installed in the SSTF. Routine PTS hardware maintenance functions however, will be provided by SSTF M&O personnel as described in Section 3.2.10. The PD has responsibility for the following PTS M&O tasks:

a. Onsite technical support for the PTS during standalone operations, integration, and test

b. All modification of PTS hardware and any maintenance and repair tasks not supported by SSTF M&O

c. Furnishing any specialized tools required for PTS maintenance and repair not included in the standard set of tools available in the SSTF Rack Build-Up area, as defined in Appendix I, Section 10.3.5

d. Performance of all maintenance and updates to the PTS software

The PD shall provide the SSTF with a list of contacts for emergency maintenance of the PTS.

3.1.9 PTS Sustaining Engineering Support

The PD has responsibility for providing or otherwise arranging for sustaining engineering support for their PTS hardware and software after it is delivered to the SSTF. The PD has responsibility for the following PTS sustaining engineering tasks, unless they are delegated to another organization:

a. Support of PTS hardware integration into the SSTF, including changes required to comply with SSTF interfaces

b. Preparation of the PTS for training sessions, including reconfiguration and preparation of PTS hardware and software

c. Activities required for a PTS after a training session, including any required safing, deconfiguration, return of LSE or stowage items to storage, etc.

d. Correction of latent defects in PTS hardware and software

e. Updating of PTS hardware and software to provide new capabilities

f. Revision of documentation and training-dependent data to correct latent defects or to implement new capabilities

3.1.10 PTS Removal and Packing

If PTS hardware is to be removed from an SSTF ISPR or other SSTF rack, the PD has primary responsibility for the removal. SSTF personnel will provide assistance, under the direction of the PD, as specified in Appendix I, Section 10.4.6. If any tools are required beyond those listed in Appendix I, Section 10.3.4, they shall be provided by the PD.

The PD is responsible for ensuring that all components of the payload training delivery package are accounted for and repacked properly for return shipping and is expected to be present when inventory and packing occurs. The PD may request SSTF personnel to provide packing and handling assistance as specified in Appendix I, Section 10.4.7

3.1.11 Shipment From the SSTF

Return shipment of training material will be arranged by the SSTF and NASA JSC as specified in Appendix I, Section 10.4.8. The PD is responsible for providing properly packed containers labeled for return shipment and for providing any special return shipping instructions.

3.2 SSTF and PTC Support Roles and Responsibilities

The following sections define the roles and responsibilities of organizations that support payload operations training at the SSTF. The roles and responsibilities are divided among the POIF (including Simulation Engineering) and NASA JSC. The roles and responsibilities are presented in the typical order in which they are provided to support payload operations training.

3.2.1 PTS Development Support

POIF personnel are responsible for chairing TSTs to determine, among other things, whether a PTS is required at the SSTF to support payload operations training. When the decision is made, POIF personnel are responsible for providing PDs with the PUDG and the generic PSRD with the appropriate payload-independent appendix to support development of the PTSs.

POIF personnel are responsible for providing technical support to the PD during the development of the PTS. Technical support may include the following:

a. Telephone and teleconference support

b. Technical support to the PD formal reviews

3.2.2 Payload Training IOS Display Development Support

The NASA JSC Space Flight Training Division (DT) has primary responsibility for development of IOS displays with support from POIF personnel, SSTF personnel, and the PD. Details of the entire process are given in Appendix II. Activities by DT, POIF, and SSTF personnel prior to the arrival of the PTS at the SSTF include the following:

a. Review information provided by the PD about payload experiment operational objectives and instructor displays used by the PD to develop basic understanding of the training conducted by the PD and PTS operation. Evaluate PD training instructor displays for possible carryover to the SSTF environment.

b. Define the functional types of IOS displays required for PTS operation in the SSTF.

c. Review the design of PTS models and controls to ensure that support for IOS displays is integrated into the design.

d. Define specific display requirements in Volume II of the PSRD.

e. Work with PD personnel to identify PTS parameters required to support IOS displays and include specifications for the parameters in Volume II of the PSRD. Ensure that specifications agree with the standardized buffer interface described in PUDG Appendix III, Section 30.6.

f. Design IOS display formats and coordinate with PD personnel as development of the PTS and IOS display formats continues to ensure agreement between them. This is expected to be an iterative process.

g. Build displays using the standard SSTF display definition tool (currently Sammi, the Kinesix Corporation COTS display builder/manager). PTS IOS displays must use engineering principles and criteria as identified in SST-204, Volumes 1 and 2.

h. Test displays, identify and document display discrepancies, correct problems, and retest displays. This process will be repeated as required to test displays as completely as possible prior to the arrival of the PTS at the SSTF.

3.2.3 SSTF Sustaining Engineering

The SSTF has responsibility for sustaining engineering tasks required to support training using specific PTSs and the combination of PTSs for each flight Training Load Delivery (TLD). Sustaining engineering tasks include the following:

a. Technical support to the TST and review of Volume II of the Payload Simulator Requirements Document

b. Engineering modifications to the SSTF such as changes to software or hardware to prepare for training on a flight load basis

c. Engineering modifications required to the SSTF to support deployment of a particular PTS, including modifications for approved waivers.

d. Modifications to SSTF hardware or software to fix latent defects

3.2.4 Configuration Management

If any training-dependent data is to be entered into SSTF computer systems, entry will be controlled by SSTF personnel using SSTF CM procedures. If the PD provided any specific instructions regarding the transfer of training-dependent data, the instructions will be followed so long as they do not conflict with SSTF CM procedures. The SSTF procedures are consistent with procedures identified in JPG-2810.1, Johnson Space Center Information Technology (I/T) Security Handbook, which governs the security of company and personnel proprietary information.

PTS software will not be loaded into SSTF system computers. Media containing PTS software or related data will be processed according to SSTF procedures for other physical items. In addition, computer-readable media will be subject to security requirements as specified in Appendix I, Section 10.6.4. Arrangements can be made for secure storage of working copies and disaster recovery copies of PTS software provided by the PD.

Procedures for SSTF CM of PTSIs are given in Appendix IV, Section 40.4.3.

3.2.5 Receiving

The SSTF is responsible for receiving the payload training delivery package at the SSTF. Additional information about receiving procedures is given in Appendix I, Section 10.4.4.

3.2.6 Unpacking

While the PD has primary responsibility for unpacking the payload training delivery package, the SSTF is responsible for providing assistance, under the direction of the PD, as specified in Appendix I, Section 10.4.3.

3.2.7 Payload Simulator Inventory and Interface Checkout

SSTF and POIF, with support from the PD and NASA DT personnel, will perform a Payload Simulator Inventory and Interface Checkout (PSIIC) activity when unpacking is complete. This task ensures the PTS was delivered safely and complete, operates as demonstrated at the PD site, and hence, can be successfully integrated and operated in the SSTF environment.

3.2.7.1 Inspection (PSIIC – Phase 1)

SSTF Logistics personnel, supported by POIF Simulation Engineers, are responsible for inspecting all payload training delivery packages in the SSTF receiving area and for verifying deliverable items against a PD-provided inventory listing. Inspection procedures are described in Appendix I, Section 10.4.4. The PTS will be tested by the POIF Simulation Engineer (with

SSTF support) to verify that all components arrived undamaged and that the PTS can be safely powered on. (This is informally known as the "smoke test.")

3.2.7.2 PTS Integrity Test (PSIIC – Phase 2)

Each integrated PTS is expected to have been tested by the PD before it is shipped to the SSTF by using a STEP and STFx to execute specified test scripts to verify that it operates properly and meets SSTF interface requirements. SSTF personnel will use a STEP and STFx with the PTS in SPTC mode to execute the specified test scripts and to perform additional interface verification and testing using procedures documented in Volume II of the PSRD for each PTS. This will verify that the PTS interfaces were correctly implemented by the PD, that interface connections were not damaged during shipment, and that the PTS will not harm the SSTF host environment. At this point, the SSTF may conduct any other testing deemed necessary or desirable to ensure successful integration.

3.2.8 PTS Integration, Verification, and Test

SSTF personnel are responsible for performing the physical integration of PTS racks into the SSTF and the interface test and verification of PTS hardware and software. Specific procedures to be followed for installation and verification of PTS hardware and software are given in the PTS User's Guide as specified by the applicable appendix to the payload-independent PSRD.

3.2.8.1 Rack Movement

SSTF personnel are responsible for moving PTS racks within the SSTF. Refer to Appendix I, Section 10.4.5 for more information.

3.2.8.2 Interface Checkout and Integration

3.2.8.2.1 Hardware Interface Checkout and Integration

SSTF personnel are responsible for checkout of the interfaces between SSTF hardware and PTS hardware. This process will ensure that PTS hardware interfaces are compatible with the physical resources and data services available in the crew station elements. SSTF personnel are responsible for checkout of the following hardware interfaces:

a. Correct hardware connectors for the following data interfaces

    1. Payload local bus (MIL-STD-1553B)

    2. Payload Ethernet Hub Gateway (PEHG)

    3. National Television Systems Committee (NTSC) composite RS-170 video

    4. SSTF PSimNet Ethernet

b. Correct electrical power connectors

c. Compatibility of jumper cables, adapters, and extensions with SSTF-provided connectors

SSTF personnel are responsible for connecting PTS hardware to the resource(s) and data interface(s) required for operation. This is done to check PTS operation and to detect hardware faults prior to integration into the crew station element. Rack Data Interface Test Equipment (RDITE) will be used for functional test of hardware data interfaces applicable for each payload. RDITE includes a 1553B bus analyzer, an Ethernet analyzer, and a Versa Modula Europa (VME) bus analyzer. SSTF personnel are responsible for notifying the PD of any hardware discrepancies detected during these procedures.

3.2.8.2.2 Software Interface Checkout

SSTF personnel are responsible for checkout of the interfaces between SSTF software and integrated PTS software against PTS documentation and the software interfaces specified in Appendix III. Interface testing will be performed using a STEP for testing C&DH interfaces and an STFx for testing the PSimNet interface. Testing will be repeated after connections to the SSTF real-time session equipment are made and verified. A set of test scripts will be required to be executed successfully before an integrated PTS is accepted for use in the SSTF.

3.2.8.2.3 IOS Display Integration and Test

NASA JSC DT personnel have primary responsibility, with support from POIF, SSTF, and PD personnel, for development of test procedures, integration, and testing of the operation of IOS displays with an integrated PTS as specified in Appendix II. Activities include the following:

a. After the PTS has been installed in the SSTF, use the IOS displays to activate and operate the PTS to ensure that the IOS displays can be used to control the PTS as part of the SSTF string and that IOS display variables interface with the correct PTS variables. This testing is part of the Payload Simulator Acceptance Test (PSAT) for the PTS.

b. Analyze problems identified during IOS display testing to determine the problem source.

c. If problems found during IOS display testing are determined to be caused by discrepancies in the display definition, make changes as required. In all cases, ensure that corrective action has been taken and coordinate retesting of the IOS displays with the PTS.

d. When testing of displays is successful, complete the process required to baseline the displays for training and to place them under configuration control.

3.2.9 PTS Interface Verification, Testing, and Acceptance Reviews

Volume I of SSP-58026, Generic Payload Simulator Requirements Document, defines the process flow for PTS interface verification, testing, and acceptance of individual PTSs. The following is a synopsis:

a. A Pre-Ship Test will be performed by the Simulation Engineer and PD prior to shipping the PTS to the SSTF. This test will verify that the PTS meets performance requirements, including host interfaces and simulated payload malfunctions. A STEP and STFx will be used to emulate SSTF interfaces.

b. A PSIIC will be performed as described in Section 3.2.7 after the PTS arrives at the SSTF.

c. A PSAT will be performed by the Simulation Engineer after the PTS is integrated into the host environment; this is essentially a rerun of the Pre-Ship Test. PSATs will not be required for PTSs with no host interface (e.g., Class IV or Class V PTSs as defined in Section 4.1), as equivalent testing will occur during the Payload Training Dry Run (PTDR).

d. A PTDR will be conducted by the Simulation Engineer, with DT, SSTF, and crew representative support. It will be a dry run or dress rehearsal of all payload crew classroom and hands-on training associated with a given payload. The PTDR will demonstrate the completeness and accuracy of the PTS, courseware, procedures, and any other training materials, and the readiness of the instructor. Training objectives that constitute criteria for PTDR evaluation will be defined in specific Training Lesson Plans, referenced in Appendix J of SSP-58309, Payload Training Implementation Plan (PTIP).

When all PTSs for a flight are integrated into the SSTF, the NASA training organization will conduct a Payload Complement Requirements Test (PCRT). The PCRT will verify that the complement of PTSs for the flight will operate together properly following a realistic timeline using the training load for the complement. SSTF and POIF personnel will provide support for this test as required.

At the successful conclusion of Quality Assurance (QA) verification procedures, the PTSs for a flight are accepted and ready for training operations.

3.2.10 Maintenance and Operations Services

The SSTF has responsibility for M&O tasks related to SSTF and PTC facilities including the technical, logistic, support, and administrative activities required for routine operation, service, and maintenance of the SSTF in support of training. SSTF M&O tasks include the following:

a. Preparation for training sessions, including reconfiguration and preparation of SSTF hardware and software

b. Routine operation during training sessions

c. Minor hardware maintenance functions

The SSTF has responsibility for operations tasks related to PD-provided PTSs and other items including the logistic, support, and administrative activities required. SSTF PTS-related operations tasks include the following:

a. Moving of PTSs as required for maintenance to be performed by the PD

b. Storage of spares and consumables provided by the PD

The instructors are responsible for day-to-day operation of the PTSs in the SSTF.

SSTF M&O will also perform routine maintenance service on the PTS hardware. These activities are conducted using general shop tools and supplies available in the SSTF M&O work area and summarized in Table 3.2.10-I.

Table 3.2.10-I SSTF M&O Maintenance Tools and Supplies

Tools	Maintenance Consumables
Electric Drill Set	Drill Bits
Nut Driver Set	Storage Bags
Socket Set	Saw Blades
Saws (Band and Hack)	Fasteners (Screws, Bolts, Nuts, Washers)
Files/Grinders	Grommets
C-Clamps	Batteries
Wrenches	Light Bulbs/Lamps/Light Emitting Diodes (LEDs)
Pliers	Cable/Wire
Chisels/Punches	Cable Ties/Connectors
Cable/Wire Stripping Tools	Wire Nuts
Cable Cutters	Cleaning Pads/Cloths
Crimping Tools	Cleaning Fluids
Extraction/Insertion Tools	Electric Fans
Hammers/Mallets	Circuit Breakers
Screwdrivers	Storage Bins/Racks
Inspection Mirrors	Receptacles/Junction Boxes
Soldering Gun	Terminal Lugs/Connectors
Shop Lamp	Locks/Keys
Vise	Soldering Materials
Digital Multimeter	Tape
Safety Glasses	Heat Shrink

Tools	Maintenance Consumables
Paint Brushes	Power Supplies
Broom	Data Cartridges
	Disposable Plastic Gloves

SSTF M&O services are generally limited to

a. Replacement of PTS front panel light bulbs/LEDs

b. Replacement of easily accessible filters

c. General rack face cleaning

Spare parts and consumables that are required and are not available from the SSTF M&O will be provided by the PD.

3.2.11 PTS Removal and Packing for Return

If PTS hardware is to be removed from an SSTF ISPR or other SSTF rack, SSTF personnel will provide assistance, under the direction of the PD, as specified in Appendix I, Section 10.4.6. SSTF personnel will provide packing and handling assistance, under the direction of the PD, as specified in Appendix I, Section 10.4.7.

3.2.12 PTS Return Shipment

SSTF personnel are responsible for coordinating return shipping arrangements unless the PD has requested to make their own arrangements. Additional information can be found in Appendix I, Section 10.4.8.

4. SSTF PTC DESCRIPTION

The SSTF is a strategic, permanent resource located at NASA JSC in Houston, Texas, established for the purpose of providing the capability to perform full-mission training of ISS flight crewmembers and GSP. The SSTF provides facilities, services, training equipment, and simulations of Space Station modules and the environment.

The PTC provides additional facilities and services to support integration of PD-provided PTSs into the SSTF. It supports operation of PTSs to train ISS flight crewmembers and GSP on the operation of U.S.-sponsored payloads residing in the ISS. Additional information about SSTF PTC training facilities is given in Appendix I, Section 10.3.

The SSTF and PTC include all the hardware and software resources necessary to control and monitor training sessions and to interface with PTSs. Computational resources include session host computers, Crew Station Input/Output Processors (CSIOPs), and IOSs.

The SSTF is capable of supporting training for the following:

a. Nominal and off-nominal operation of Space Station systems, including simulated malfunctions

b. Nominal and off-nominal operation of payloads, including simulated malfunctions

Training is conducted in sessions in which specific, available SSTF and PTC resources are configured together to form a virtual Space Station to support a specific type of training and objective. For example, to support payload training, the U.S. Laboratory Trainer Module (Lab) or the Secondary Lab (SLab), including its CSIOP with one or more PTSs installed in ISPRs, a session host computer, a C&DH string, and at least one IOS would be configured into the session. Two simultaneous sessions that include crew station elements can be configured with each session containing an IOS functioning as an operator station from which the training session is controlled and the simulations monitored. Each crew station and IOS can be configured into either session, but cannot be included in both sessions simultaneously. In addition, one session can be configured for POIC training as described in Section 4.15.

The SSTF and PTC are capable of supporting training modes as defined in SST-635, Level A Requirements for the Space Station Training Facility.

4.1 PTS Classifications

For training purposes and to present a common definition of PTS fidelity, the NASA training organizations have identified five major classes of PTSs as follows:

a. Class I – Flight Equivalent Unit (FEU), including engineering units, flight-like hardware that may or may not be flight certified or a nonradiation-hardened COTS equivalent interfaced to the SSTF C&DH emulation.

b. Class IIb – An integrated PTS with flight-like hardware panels with fully functional Controls and Displays (C&D) and a PD-provided software simulation in a PSE computer interfaced to the SSTF system simulations and the SSTF C&DH emulation.

c. Class IIIb – An integrated PTS with standalone systems with virtual panels and a PD-provided software simulation in a PSE computer interfaced to the SSTF system simulations and the SSTF C&DH emulation.

d. Class IV – Flight-like hardware or virtual panels with simulation as defined by the TST but without all interfaces to the SSTF FTT.

e. Class V – Inert display, picture, or faceplate with no operational switches or displays.

Class I PTSs and FEU components of other PTSs can be accommodated in the SSTF, provided that any resources (fluids, vacuum, power, etc.) beyond those included at the SIP are provided by the PD, and that the PTS and all support resources are contained within a volume equivalent to an SSTF ISPR. Any additional resources shall be documented in the Payload Data Library (PDL) dataset. All components and support equipment for a PTS of any class shall comply with the handling procedures and limitations in Appendix I, Sections 10.4 and 10.5. Details of the PTS implementation will be documented in the PTS User's Guide. The differences in functionality of the PTS classes supported in the SSTF are as follows:

Functionality	Class IIb	Class IIIb	Class IV	Class V
C&D panels that provide nonfunctional controls	Yes	No	Yes	Yes
C&D panels with functional controls that provide status, monitoring, and control functions via flight-like hardware panels	Yes	No	Yes	No
C&D panels with functional controls that provide status, monitoring, and control functions via virtual panels	No	Yes	Yes	No
Payload simulator software executing in a payload simulator-unique processor	Yes	Yes	Yes	No
Interfaces to C&DH emulated Multiplexer/Demultiplexer (MDM)	Yes	Yes	No	No
Interfaces to SSTF core system simulations	Yes	Yes	No	No

In addition to the above classification, which applies to a complete PTS, training device fidelity can also be classified. While this can be applied to an entire PTS, it is usually applied to outfitting components of simulators (valves, knobs, switches, lights, etc.). A PTS may contain components that are of higher or lower fidelity than the overall designation of the PTS. Training device fidelity is categorized by functionality and compliance with physical properties. In addition to flight-type devices, which are flight equipment downgraded for training or not certified, training device functionality is classified as follows:

Class	Functionality
A – Functionally Active	Replicates the active user interface of the analogous ISS hardware controls and displays, and interacts with the system models. Controls operate in the same “sense” as the flight article.
B – Operable	Includes mechanical hardware without a systems interface.
C – Static	Includes graphics or three-dimensional objects added to aid in identifying or locating controls and displays.

For training devices other than flight type, compliance with physical properties is classified as follows:

Class	Physical Properties
I	Hardware matches flight article orientation, range of motion, display resolution, sound quality, color, texture, and other relevant physical properties.
II	Hardware is three dimensional in an approximately correct relative orientation and is similar in appearance to the flight article. Size, exact color, and other physical properties not affecting the required functional fidelity may vary.
III	Hardware provides sufficient visual information to aid in locating controls and displays without regard to flight article dimensions or materials. Controls and displays are packaged on flat panel assemblies and are capable of conveying the same information in the same general manner (lights-lights, dials-dials) as the flight article, but may vary in size, exact color, and other physical properties not affecting the required functional fidelity.

4.2 U.S. Laboratory Trainer Module

The Lab provides an operating environment commensurate with the U.S. Lab flight element to the maximum extent possible in an earth-gravity environment, as necessary to support ISS flight crew and GSP training on the operation of U.S.-sponsored payloads manifested in the U.S. Lab flight element. The Lab is described in Appendix I, Section 10.3.2.

4.3 Secondary Lab Module

The SLab provides a partial representation of the U.S. Lab flight element to support ISS flight crew and GSP training on the operation of U.S.-sponsored payloads manifested in the U.S. Lab. It includes locations for six ISPRs. The SLab also provides a facility in which PTS integration and interface verification and test procedures can be conducted without impacting training sessions in the Lab and also accommodates SPTC sessions as described in Section 4.16. Individual PTSs in SLab ISPR locations can be selected to be attached to a POIC training session (refer to Section 4.15) without preventing use of other ISPR locations in a training session including the SLab asset. The SLab is described in Appendix I, Section 10.3.3.

4.4 SSTF ISPRs

The SSTF ISPR is the main supporting platform for PTS hardware used in the crew station elements. Refer to Appendix I, Section 10.3.1 for a description of ISPR locations in SSTF crew station elements. Refer to Appendix IV, Section 40.3.3, for a description of the SSTF ISPR and to Appendix III for detailed interface specifications. Refer to Appendix IV, Section 40.4, for information about obtaining a GFE SSTF ISPR to contain a PD-developed PTS.

4.5 SSTF System Simulations

The SSTF supports the operation of PTSs by providing simulations in the SSTF flight systems that support payload operations training, including payload-to-system interface troubleshooting. Each Class IIb or IIIb PTS shall interface with the following SSTF system simulations:

a. Onboard Computer System (OBCS) via 1553B

b. Environmental Control and Life Support System (ECLSS) including the Laboratory Nitrogen System (LNS) and Vacuum System (VS) via PSimNet

c. Electrical Power System (EPS) via PSimNet

d. Thermal Control System (TCS) via PSimNet

The SSTF also includes Communications and Tracking (C&T), Guidance, Navigation, and Control (GN&C), and Environment (ENV) simulation software as described below.

The SSTF system simulations operate under the control and monitoring of instructors and operators at dedicated IOSs. Prior to a training session, the operator specifies the combination of simulation hardware and software to be used during the session. The instructor interfaces with the system simulation software via the IOS for computer-controlled functions. The instructor manually interacts with system simulation hardware, which is not computer controlled during the training session setup. The instructor sets and clears malfunctions (simulated system faults) to support payload-to-system fault operations training. The SSTF does not use real hardware (i.e., valves, circuit breakers, fuses, etc.) to simulate hardware faulting.

The SSTF provides simulation of the connection status for 120 VDC main power, 120 VDC auxiliary power, low-temperature coolant supply and return, moderate-temperature coolant supply and return, LNS, vacuum resource, and waste gas exhaust at each crew station element ISPR location.

A connect-status signal is derived when an SSTF-supplied umbilical is properly installed between the SIP and the IIP. The IIP connector pins are jumpered to complete the connect-status circuit. The simulated 120 VDC connectors on the IIP are keyed to prevent cross-connection. The simulated vacuum and fluid connectors are not keyed to physically prevent cross-installation. The connectors and umbilicals will be labeled and electrically keyed such that connect status will not be returned to the SSTF simulation software by an incorrectly connected umbilical.

When the connect-status signal for a utility at an ISPR location indicates connection, the values provided via the PSimNet to an integrated PTS at that location will be as derived by the corresponding SSTF system simulation model. When a connect-status signal for a utility at an ISPR location indicates no connection, the value provided via the PSimNet to a PTS at that location will indicate that the utility is unavailable, as specified for each of the systems in the following sections.

The following sections provide overviews of the SSTF system simulations. Any simulations required beyond those provided by the SSTF shall be provided within the PTS by the PD unless otherwise negotiated during the TST process. Information on specific interface definitions between the SSTF core systems simulation and PTS models are contained in Appendix III, Section 30.3.3.1.

4.5.1 Onboard Computer System Simulation

The OBCS simulation uses a combination of hardware and software to provide a full-system signature simulation of the ISS onboard C&DH system and its interface components. The C&DH supports ISS systems command and control, supports ISS payload (science) users, and provides the services for flight crew and ground operations. The principal computer hardware device employed to provide distributed computational resources for the ISS OBCS simulation and C&DH utilities and services is the MDM. The C&DH architecture is divided into three tiers of Flight Software (FSW) processors and associated functions. The command and control computers are at the highest level and provide the point of control for several middle tier functions, including core and payload systems and International Partner interfaces. The lowest tier of processors and functions, under management of the middle tier functions, directly controls and monitors ISS-distributed system components.

To capture the full and accurate functionality of the C&DH, the OBCS simulation provides capabilities that simulate the execution of the to-be-flown operational FSW within the real-world rates. Using special simulator hardware (MDM emulator and/or functionally equivalent unit) and software, the OBCS simulation, in conjunction with other SSTF simulation subsystems, provides the MDM FSW execution environment and command response interface stimulation necessary to attain full ISS mission C&DH functionality for the SSTF.

Other C&DH components provided or simulated by the OBCS simulation include the following:

a. Portable Computer Systems (PCSs) for flight crew interface

b. Payload Ethernet and the hub function of the PEHG, which supports data transfer among integrated PTSs and between integrated PTSs and Ethernet laptops (PCSs) connected via the Utility Outlet Panels (UOPs)

c. Automated payload switch for Ku-band health and status downlink selection

d. MIL-STD-1553B bus components that connect the C&DH to other ISS systems, including integrated PTSs

e. Standard MDM analog/discrete input/output connectivity to other ISS systems

For more details on the SSTF OBCS C&DH simulation of PTS interfaces, see Appendix III, Section 30.3.3.2.

4.5.2 Communications and Tracking Simulation

The C&T simulation uses a combination of hardware and software to simulate the services provided by the S-band and the Ku-band. The C&T simulation includes the uplink and downlink capabilities of the S-band communication link. The S-band uplink simulation supports payload and system commands, software, file transfers, and audio data. The S-band downlink simulation supports core system information, return audio, and health and safety data. The C&T simulation includes the functions of the Ku-band communications link used to support the downlink of payload health and status data and video data. The C&T simulation supports High-Rate Data Link (HRDL) capabilities only for payload health and status data.

4.5.3 Environmental Control and Life Support System Simulation

The ECLSS simulation is a software-only simulation of the internal atmosphere of the ISS, including thermodynamics and mass properties of the major constituents of atmospheric gases. The ECLSS simulation also includes the LNS and the VS simulations as well as a Fire Detection System (FDS) model.

4.5.3.1 Laboratory Nitrogen System Simulation

The LNS simulation uses software to simulate provisions of gaseous nitrogen to the ISPRs. The LNS simulation software includes the following flight LNS components:

a. LNS main line

b. LNS standoff lines

LNS simulation software accepts Tier 1 commands to simulate LNS standoff service and to manipulate simulated LNS valves. The LNS status is updated based on Tier 1 commanding and LNS simulated malfunction settings. LNS simulation software provides the current simulated nitrogen pressures for each ISPR standoff to each PTS integrated into the session cyclically via the PSimNet. The rate of nitrogen usage shall be provided cyclically by each PTS to the ECLSS simulation via the PSimNet. ECLSS Atmosphere Control and Supply (ACS) is simulated from startup to the state in which nitrogen is provided to the LNS main line valve and LNS shutdown.

The LNS simulation software will simulate gaseous nitrogen at the pressure and flow rate specified to each ISPR location in all crew station elements included in the session.

4.5.3.2 Vacuum System Simulation

The VS simulation uses software to simulate Vacuum Exhaust System (VES) and Vacuum Resource System (VRS) valves and sensors, the manual valve, and motor-operated valve manual override capability. The VS simulation software dynamically includes normal operations, safeguard operations, maintenance, and shutdown modes.

The VS simulation software provides the current VES and VRS simulated vacuum pressures at each ISPR interface to each PTS integrated into the session cyclically via the PSimNet. The rate of waste gas exhausted by the payloads, which affects the standoff vacuum pressures, shall be provided cyclically to the ECLSS simulation by each PTS via the PSimNet.

4.5.3.3 Cabin Environment Simulation

The ECLSS model includes a software-only simulation of the internal atmosphere of the ISS, including thermodynamics and mass properties of the major constituents of atmospheric gases. The ECLSS simulation software provides the current cabin temperature and pressure to each PTS integrated into the session cyclically via the PSimNet. Only the amount of heat flow to the cabin atmosphere shall be provided cyclically to the ECLSS simulation by each PTS via the PSimNet.

4.5.3.4 Fire Detection System

The FDS simulation models the smoke detector equipment within the racks. In a simulated fire condition, signals from the simulated smoke detectors are sent via MDM FSW and SSTF SCE to drive the rack FDS indicator on. The FDS model also commands the FDS indicator off via MDM FSW and SSTF SCE when conditions warrant. No indication of FDS indicator status is provided to the PTS. The PTS shall model any ISPR real-world fire detection equipment that is self-contained (in an enclosed volume isolated from adjacent racks or the cabin) as determined by the TST.

The FDS/MAINT panel described in Appendix IV, Section 40.3.5, includes a FDS indicator that complies with the required SSTF interface. If the PD does not use a FDS/MAINT panel, a FDS indicator that provides the equivalent interface must be included in an integrated PTS. The maintenance switch simulation is described in Section 4.5.4.

4.5.4 Electrical Power System Simulation

The EPS simulation uses software to simulate the portions of the flight secondary and remote (tertiary) power distribution systems used by ISPRs and those core systems represented in the trainer.

The EPS simulation software provides values for simulated EPS channel voltages to each PTS integrated into the session cyclically via the PSimNet to simulate the application and removal of power to simulated hardware. The SSTF EPS model responds to MDM FSW commands that control Remote Power Controller Modules (RPCMs) supplying power to rack equipment. MDM

EPS flight software senses the state of a simulated Rack Power Switch (RPS) for switching simulated RPCMs on/off.

The EPS simulation models the RPS within the racks. The position of a functional RPS simulation at each rack position is sensed by the SSTF SCE. Status is relayed to the SSTF simulation software EPS model, and subsequently to the emulated MDM for processing by flight software. The MDM output is sent back to the EPS model that controls the simulated RPCM. If the processing results in the simulated 120 VDC being removed from an ISPR, the value for Main and Auxiliary voltage available sent to the PTS via the PSimNet will be zero volts.

No actual switching of the 208/120 VAC power provided at crew station element ISPR locations is performed, so power is maintained to the PTS hardware. Any actual switching of power to payload rack crew indicators (lights, meters, sounds, etc.) must be provided by a combination of PTS software and hardware.

The FDS/MAINT panel described in Appendix IV, Section 40.3.5, includes a functional simulated RPS that complies with the required SSTF interface. If the PD does not use a FDS/MAINT panel, equipment that provides the equivalent interface must be included in an integrated PTS. The FDS simulation is described in Section 4.5.3.4. Note that the RPS was previously known as the Rack Maintenance Switch (RMS) and that name is still used in some SSTF documents and drawings.

Each integrated PTS shall provide simulated EPS channel load levels based on EPS channel voltages to the EPS simulation software cyclically via the PSimNet. Power loads for core systems not required for training support are simulated as constant power loads on the Secondary Power Distribution Assembly (SPDA) RPCMs.

The EPS simulation hardware provides an emulation of power at flight UOPs utilized onboard the ISS. The crew station UOPs provide 120 VDC power service to support the operation of the LSE. The UOPs are located in the Lab in positions that are commensurate with the U.S. Lab flight element and in other crew station elements in locations to support training. The only actual power available at crew station rack locations is 208/120 VAC. If PTS hardware requires any other type of power, it must be converted within the PTS.

4.5.5 Guidance, Navigation, and Control Simulation

The GN&C simulation is a software-only simulation that includes the following portions of the flight GN&C system functions:

a. Management function – Limited to Tier 1 interaction: mode changes, state vector prediction, state vector, attitude, pointing support data

b. Navigation function – ISS state vector generation

c. Attitude determination – Attitude, attitude rate generation

d. Pointing and support function – Tracking and Data Relay Satellite System (TDRSS), solar eclipse, data quality indicator

The GN&C simulation does not include the guidance, traffic management, or attitude control functions of the flight GN&C system. The GN&C simulation does not include any hardware components of the flight GN&C system because ISS orbit and attitude status are derived directly from instructor-defined orbital and attitude data.

4.5.6 Thermal Control System Simulation

The TCS simulation is a software-only simulation that includes the internal and external passive and active thermal control functions of the ISS. The Internal Active Thermal Control System (IATCS) simulation includes the nominal and faulted operation of the Moderate Temperature (MT) and Low Temperature (LT) payload Rack Flow Control Assemblies (RFCAs). Coolant supply and return line temperature and flow rates are simulated dynamically. The rates are affected by RFCA coolant outlet temperatures and flow rates. The IATCS loop hardware System Flow Control Assembly (SFCA), the Loop Crossover Assembly (LCA), and the pump are simulated statistically.

The TCS simulation software provides the current flow rates and temperatures for the LT and MT loops at each ISPR interface to each PTS integrated into the session cyclically via the PSimNet. The heat added to the LT and MT loops and the MT loop valve position shall be provided cyclically to the TCS simulation by each PTS via the PSimNet.

4.5.7 Environment Simulation

The environment simulations are software-only simulations of the ambient space environment that exists in the ISS orbital plane. Effects such as gravity, magnetic fields, and solar sunrise/sunset data, which can affect payloads and the ISS systems, are simulated.

4.6 Real-Time Sessions System

The Real-Time Sessions (RTS) system provides the following capabilities:

a. Real-time scheduling and synchronization of the SSTF models in a distributed environment

b. Mode control of all assets attached to a training session

c. Real-time messaging system instead of the traditional common datapool

d. Connectivity services to the networks that connect the distributed computational platforms

e. Distributed timing services using the Central Timing Equipment (CTE), including maintaining values for Greenwich Mean Time (GMT) and Simulated Greenwich Mean Time (SGMT), which are provided to each PTS integrated into the session via the PSimNet

f. File management, operating system services, and the run-time environment for the distributed computational platforms

4.7 Operations Support System

The Operations Support System (OSS) provides the following:

a. Initial system logon and user access verification

b. Status and control of multiple training sessions

c. Adding and dropping of assets to a training session

d. Time tagging, recording, and displaying error and event messages

e. Basic network monitoring and management functions

f. Data collection and analysis tools

g. Utility tools such as simulation event recording, scripting tools, and data logging

4.8 Training-Dependent Data

Training-dependent data is used to support payload operations training conducted in the SSTF. Training-dependent data processed by the SSTF session host computer string consists of training scripts and IOS display definition files. Training-dependent data required by an STFx includes STFx training scripts, data message definitions, and STFx display definitions. Training-dependent data related to the PTS implementation and required to support integration of the PTS into the SSTF and use of the PTS in SPTC sessions is defined in Section 3.1.2.1.

4.8.1 Training Scripts

SSTF training scripts are used to issue predefined commands during a training session to control and monitor the session and invoke malfunctions. SSTF training scripts can include commands related to SSTF components and any commands supported by an integrated PTS. The PD is not responsible for producing SSTF training scripts.

STFx training scripts are used to execute predefined sequences during a test session to control system models in the STFx, to control an attached STEP, to send commands and malfunctions to an attached PTS via the PSimNet interface, and to otherwise control and monitor the session. Procedures to define STFx training scripts are included in SST-646.

4.8.2 IOS Display Definition Files

An IOS display definition file can specify PTS-specific data that is to be displayed in a specified format and location on an IOS workstation during integrated PTS operations. Procedures for developing IOS displays are documented in Appendix II.

4.8.3 STFx Data Message and Display Definitions

For an STFx to be used with a particular PTS, the data parameters to be exchanged between the STFx and the PTS and any PTS-unique STFx displays must be defined. This information shall be provided as specified in Volume II of the PSRD for the PTS.

4.9 Payload Resource Utilization Models

The PRU models are software simulations in the SSTF session host computer of flight resource usage and interfaces by U.S.-sponsored pressurized and attached payloads that are included in the operational scenario for the current training session, but that do not have a functioning Class IIb or Class IIIb PTS active in the session. The PRU models for all payloads in the operational scenario are included in the session software configuration. They are inactive if a corresponding Class IIb or Class IIIb PTS is active. If the TST determines that an integrated PTS is required for a particular payload, resource and interface utilization data for the PRU model are specified in Volume II of the PSRD. If the TST determines that an integrated PTS is not required for a particular payload, POIF Simulation Engineers will provide resource and interface utilization data for the PRU to the SSTF. Refer to Appendix III, Section 30.5, for a description of the PRU data required.

4.10 SSTF IOSs

The SSTF provides IOSs to support three session training strings. Instructors and operators at the IOSs can activate, control, monitor, and terminate payload operations training sessions conducted in the SSTF. The SSTF IOS provides the instructor and operator the following capabilities with respect to integrated PTS operation:

a. Monitor parameters from PTS software via provided displays

b. Enter commands (scripted and/or interactively inserted) that control the PTS during the training session

c. Control, monitor, and command system simulation software

d. Issue mode changes

e. Introduce malfunctions

f. Communicate with flight crewmembers via the Digital Voice Intercommunication Subsystem – SSTF Extension (DVIS-SE)

g. View video distributed through the Video Switching and Distribution (VSD) subsystem, including video generated by PTSs and output via the SSTF ISPR video interface (not available on the third string)

4.11 SSTF PSimNet Ethernet

The SSTF PSimNet Local Area Network (LAN) provides a communication link between the CSIOP and each PTS integrated into the training session. It is used for SSTF host system commanding and mode control of the PTS, for exchanging simulation model data between the SSTF system simulation models and the PTS, for making data from a PTS available for display at an IOS, and to support IOS actions to send data values and malfunction commands to the PTS. The PTS will receive periodically updated values of simulation data computed by the SSTF system simulations as described in Section 4.5. The PTS is required to provide periodic updates to resource utilization data as computed by its simulation model. Refer to Appendix III, Section 30.4, for information on the physical and logical interfaces between the PTS and the PSimNet. Refer to Appendix III, Section 30.3.3.1, for requirements for the data to be received from the SSTF core system simulation and to be sent to the SSTF core system simulations to satisfy the minimum set of core systems interfaces. Refer to Appendix III, Section 30.6, for procedures to define other PTS data parameters transferred via the PSimNet. Note that the PSE and STFx include support for the PSimNet interface. For more information about the PSE and STFx, refer to Appendix IV, Appendix V, and SST-646.

4.12 Signal Conversion Equipment Input/Output

SSTF SCE provides for Input/Output (I/O) interfaces between the SSTF host and SSTF-provided equipment, including some SIP/IIP connections at crew station element rack locations. SCE data types include discrete input, discrete output, analog input, and analog output. SSTF SCE connections at the SIP are defined in Appendix III, Section 30.4.3.2.2. SSTF SCE connections at the IIP are defined in Appendix IV, Section 40.3.4.

4.13 Video Switching and Distribution Subsystem

The SSTF includes a VSD subsystem that provides capabilities for routing video signals between training modules and facilities. Connectors for NTSC composite RS-170 video output are available at each SSTF crew station element ISPR location. Video generated by an integrated PTS can be viewed at an IOS or on monitors in the briefing/debriefing rooms. It can also be routed to other locations, including Mission Control Center – Houston (MCC-H) and Huntsville Operations Support Center/Payload Operations Integration Center (HOSC/POIC).

4.14 Digital Voice Intercommunication Subsystem – SSTF Extension

The SSTF includes a DVIS-SE subsystem that provides an interface between the SSTF components and the JSC Digital Voice Intercommunication Subsystem (DVIS) located in Building 30. The DVIS-SE includes DVIS keysets and jackboxes located in crew station elements and throughout the SSTF and support equipment to allow connection to the JSC DVIS. The DVIS-SE and JSC DVIS will distribute SSTF-generated simulated Space Station voice communication channels, crew intercommunication (intercom) loops, and maintenance communication loops among the SSTF crew stations, instructor stations, and other network subscribers. For more information about JSC DVIS and DVIS-SE, refer to JSC-36265, Space Station Training Facility to Johnson Space Center Operational Communications Interface Control Document.

4.15 POIC Training Capability

The SSTF PTC provides a POIC training capability that supports training of GSP at the POIC. One SSTF session can be configured for POIC training without requiring use of the MCC-H or any SSTF crew station elements. The POIC training capability will include PSEs to contain software-only models of payloads. Optionally, individual PTSs in SLab ISPR locations can be selected to be attached to a POIC training session without preventing use of other SLab ISPR locations in a training session, including the SLab asset. The SLab is described in Section 4.3 and in Appendix I, Section 10.3.3.

4.16 Standalone Payload Training Capability

The SSTF PTC provides an SPTC that enables an integrated PTS to be used for training in an SSTF standalone mode, independent of connections to the SSTF real-time session equipment. The SPTC is achieved by properly configuring three major components: an STFx, a GFE STEP, and a Class IIb or IIIb PTS. These three components are integrated and provide two separate functions: a payload training capability independent of the SSTF using a PD-provided PTS, or a platform for verification of a PD-provided PTS prior to integration into the SSTF.

An SPTC is configured to provide training or verification on one ISS payload per session. The STEP provides simulated vehicle interfaces (1553B and PEHG) to the PTS, and the STFx provides the PSimNet interface for moding and control and simple representations of the ISS core systems (with the exception of those provided by the STEP) to the PTS. Operational control of the SPTC components is provided by the STFx. Control of the STEP by the STFx will consist of the following:

a. Freeze/Run mode command

b. Initiate STEP script command

c. Broadcast ancillary data update

d. Unique ancillary data update

e. Datastore/Safestore command

Control of the PTS will consist of the commands identified in Appendix III, Section 30.4.2. SPTC control pages should be modeled after the corresponding SSTF IOS control displays. PD responsibilities for providing support for developing STFx displays for use in an SPTC configuration will be defined in Volume II of the PSRD for the PTS.

For a PTS to be used in an SPTC session, the STFx and STEP must be initialized with data specific to the PTS. The PD shall provide required data in the Payload Training Delivery Package as defined in Section 5.

5. PAYLOAD TRAINING DELIVERY PACKAGE CONTENTS

The PD is responsible for providing a payload training delivery package to the SSTF. The payload training delivery package shall include the integrated PTS system, including hardware and software, training courseware, and documentation related to payload training operation and maintenance. Table 5-I identifies the contents of the payload training delivery packages, the recommended quantities, and whether the item is deemed mandatory for payload operations training or is an item negotiable with the TST.

Table 5-I Payload Training Delivery Package

Description	Quantity	Mandatory/ Negotiable
Packing list	1	Mandatory
Contents documentation: complete parts list, developer contact list, special instructions, test and setup procedures	1 set	Mandatory
Integrated PTS system	1	Mandatory
PSRD Volume II	1	Mandatory
PTS User's Guide	1	Mandatory
Results for testing performed by PD, certification checklists	1	Mandatory
Payload support equipment, including any custom tools	1 set	Negotiable
Emergency shutdown procedures	1 set	Mandatory
Hardware documentation: COTS hardware user manuals, mechanical dimension drawings, interconnect/assembly drawings, schematics and wiring diagrams	1 set	Negotiable
COTS software documentation: user manuals, maintenance procedures, documentation of maintenance agreements	1 set	Negotiable
PTS implementation data as defined in Section 3.1.2.1	1 set	Mandatory
Training courseware: lesson plans, workbooks, manuals	1 set	Mandatory
Spares and consumables	1 set	Negotiable
Return instructions	1 set	Negotiable
Miscellaneous handling instructions	1 set	Negotiable
Safety documentation as specified in Appendix I, Section 10.5	1 set	Mandatory
Security documentation as specified in Appendix I, Section 10.6	1 set	Mandatory

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6. NOTES

6.1 Acronyms and Abbreviations

AC	Alternating Current
ACS	Atmosphere Control and Supply
AI	Analog Input
AO	Analog Output
ASCII	American Standard Code for Information Interchange
BSD	Berkeley Software Distribution
C&D	Controls and Displays
C&DH	Command and Data Handling
C&T	Communications and Tracking
CM	Configuration Management
COTS	Commercial Off-the-Shelf
CR	Change Request
CSIOP	Crew Station Input/Output Processor
CSMA/CD	Carrier Sense, Multiple Access with Collision Detection
CTE	Central Timing Equipment
DI	Discrete Input
DIS	Distributed Identifier Specification
DO	Discrete Output
DRLI	Data Requirements List Item
DT	Space Flight Training Division (Mail Code)
DVIS	Digital Voice Intercommunication Subsystem
DVIS-SE	Digital Voice Intercommunication Subsystem – SSTF Extension
ECLSS	Environmental Control and Life Support System
EIA	Electrical Industries Association
ENV	Environment
EPS	Electrical Power System
EXPRESS	Expedite the Processing of Experiments to Space Station
FDS	Fire Detection System
FEP	Front End Processor
FEU	Flight Equivalent Unit
FSW	Flight Software
FTT	Full-Task Trainer
GFE	Government-Furnished Equipment
GMT	Greenwich Mean Time
GN&C	Guidance, Navigation, and Control
GSP	Ground Support Personnel

HCI	Human-Computer Interface
HOSC	Huntsville Operations Support Center
HRDL	High-Rate Data Link
I/O	Input/Output
I/T	Information Technology
IATCS	Internal Active Thermal Control System
IEEE	Institute for Electrical and Electronic Engineers
IIP	ISPR-Mounted Interface Panel
IOS	Instructor/Operator Station
IP	Internet Protocol
IPC	Interprocess Communication
IPS	Internet Protocol Suite
ISPR	International Standard Payload Rack
ISS	International Space Station
ISSP	International Space Station Program
ITF	Integrated Training Facility
JPG	JSC Procedures and Guidelines
JSC	Johnson Space Center
Lab	U.S. Laboratory Trainer Module
LAN	Local Area Network
LCA	Loop Crossover Assembly
LED	Light Emitting Diode
LNS	Laboratory Nitrogen System
LSE	Laboratory Support Equipment
LT	Low Temperature
M&O	Maintenance and Operations
MAINT	Maintenance
MCC-H	Mission Control Center – Houston
MDM	Multiplexer/Demultiplexer
MIL-STD	Military Standard
MSFC	Marshall Space Flight Center
MT	Moderate Temperature
NASA	National Aeronautics and Space Administration
NTSC	National Television Systems Committee
OBCS	Onboard Computer System
OSS	Operations Support System
PC	Personal Computer
PCB	Payloads Control Board

PCRT	Payload Complement Requirements Test
PCS	Portable Computer System
PD	Payload Developer
PDC	Payload Development Center
PDL	Payload Data Library
PED	Payload Element Developer
PEHG	Payload Ethernet Hub Gateway
POIC	Payload Operations Integration Center
POIF	Payload Operations Integration Function
PRU	Payload Resource Utilization
PSAT	Payload Simulator Acceptance Test
PSE	Payload Simulator Environment
PSIIC	Payload Simulator Inventory and Interface Checkout
PSimNet	Payload Simulation Network
PSIV/F	Payload Software Integration and Verification Facility
PSRD	Payload Simulator Requirements Document
PTC	Payload Training Capability
PTDR	Payload Training Dry Run
PTIP	Payload Training Implementation Plan
PTS	Payload Training Simulator
PTSI	Payload Training Support Item
PUDG	Payload User Development Guide
QA	Quality Assurance
RAPS	Remote Area for Payload Support
RDITE	Rack Data Interface Test Equipment
RFC	Request for Comment
RFCA	Rack Flow Control Assembly
RMS	Rack Maintenance Switch
RMU	Rack Mobility Unit
ROM	Rough Order of Magnitude
RPCM	Remote Power Controller Module
RPS	Rack Power Switch
RSC	Rack Shipping Container
RTS	Real-Time Sessions
SCE	Signal Conversion Equipment
SE	Simulation Engineer
SFCA	System Flow Control Assembly
SGMT	Simulated Greenwich Mean Time
SIP	Standoff-Mounted Interface Panel
SLab	Secondary Lab
SMTF	Shuttle Mission Training Facility
SPDA	Secondary Power Distribution Assembly
SPTC	Standalone Payload Training Capability

SSCN	Space Station Change Notice
SSTF	Space Station Training Facility
STEP	Suitcase Test Environment for Payloads
STFx	Simulator Test Fixture
TCP	Transmission Control Protocol
TCS	Thermal Control System
TDRSS	Tracking and Data Relay Satellite System
TLD	Training Load Delivery
TR	Trouble Report
TSC	Training Systems Contractor
TST	Training Strategy Team
U.S.	United States
UDP	User Datagram Protocol
UOP	Utility Outlet Panel
VAC	Volts Alternating Current
VDC	Volts Direct Current
VES	Vacuum Exhaust System
VME	Versa Modula Europa
VRS	Vacuum Resource System
VS	Vacuum System
VSD	Video Switching and Distribution

6.2 Glossary

Terms in this glossary apply to the PUDG appendixes as well as to this main document.

American Standard Code for Information Interchange (ASCII)	A standardized system in which character data is represented as bits. Each character is stored in 1 byte.
Analog Input (AI)	An analog hardware value representing the state of a physical component that has been converted to a digital representation, usually 8 to 12 bits, and stored into a variable in main memory.
Analog Output (AO)	A variable in main memory that will be converted to an analog signal and imposed on a hardware device. Typically, only the low order 8 to 12 bits of the variable are used.
Asset	Hardware and software that are switchable or selectable for inclusion in or exclusion from a training session (e.g., crew stations, C&T Front End Processor (FEP), and external interfaces such as the Shuttle Mission Training Facility (SMTF) and MCC-H).

Attached Payload	A payload located outside the pressurized volume of the ISS.
Bit	The basic element of data storage. A bit may have a value of either zero or one.
Byte	A unit of data storage generally consisting of 8 bits. In the PTC context, a byte consists of 8 bits and is synonymous with octet.
Command and Data Handling (C&DH)	The ISS system that provides the hardware and software computer resources to (1) support ISS core systems command and control, (2) support the science (payload) users of ISS, and (3) provide the services for flight crew and ground operations. The SSTF includes a simulated C&DH system.
Core System	An ISS system that supports station and payload operations by providing basic resources such as electrical power, vacuum, and nitrogen.
Core System Simulation	An SSTF simulation of a core system.
Crew Station Element	A component of the SSTF that provides a mockup of an ISS component. The SSTF crew station elements currently include the Lab and SLab.
Crew Station Input/Output Processor (CSIOP)	The computational platform that interfaces various simulated ISS components such as the Lab to the session host.
Datastore	A term that refers to both the command to take a datastore and the set of values that comprises a datastore point. A datastore point is also known as a reset point. The Datastore command causes a predefined set of values to be captured and written to mass storage for later use by a Return-to-Datastore command. This set of values defines the simulation configuration and conditions.
Delivery-Critical Message	A message that must be delivered to maintain the integrity of the training session. An example is the Run command moding message.
Discrete Input (DI)	A digital hardware value representing the state of a physical component that has been converted to a binary representation and stored into a variable in main memory.
Discrete Output (DO)	A variable in main memory that will be converted to a binary signal and imposed on a hardware device.

Distributed Identifier Specification (DIS)	A method that associates logical names to physical variables for datastore, safestore, IOS displays, and malfunction data.
Environment Simulator	A software simulation of some aspect of the space environment. Environment models execute on the session host computer (e.g., gravitational forces model).
Ethernet	A LAN protocol published in 1992 by the Digital Equipment Corp., Intel Corp., and Xerox Corp. It uses an access method, Carrier Sense, Multiple Access with Collision Detection (CSMA/CD). It operates at 10 megabits per second. RFC 894 defines the Ethernet protocol used for the SSTF PTC. A good description is found in Chapter 2 of TCP/IP Illustrated, Volume 1, by W. Richard Stevens.
EXPRESS Rack	A rack used for Expedite the Processing of Experiments to Space Station (EXPRESS) payloads. It supports a simple, short integration process and provides standardized interfaces for experiments.
Facility Class Payload	A long-term or permanent ISS resident payload that provides services for a specific type of research.
Fault	An unplanned deviation from the normal, expected behavior of a core system or payload simulation. See malfunction.
Flight Equivalent Unit (FEU)	A device that uses equipment similar to flight payload equipment but that has not necessarily been subjected to flight qualifications testing.
Freeze	A term that refers to both the command to go to Freeze mode and the state of being in Freeze. When the simulator is in Freeze, simulated time is held constant. For convenience, most simulation models continue to execute using the delta time that is set to zero.
Functionally Equivalent Unit	A nonflight component that performs the same functions in exactly the same way as the corresponding flight component, but which differs in design and construction.
Greenwich Mean Time (GMT)	The actual time at which the training session is being conducted, as obtained from Central Timing Equipment. The GMT value includes the year, day of year, and milliseconds from midnight. The GMT value is distributed to SSTF computers and sent cyclically to each PTS integrated into the session via the PSimNet.

Ground Support Personnel (GSP)	Ground-based personnel who directly support the onboard operation of the ISS (e.g., POIC payload controllers).
Increment	The operational configuration of the ISS between Space Shuttle berthings. Increment also defines the operational time interval of the ISS between Space Shuttle berthings with the ISS.
Initialize	The command to initialize the training session to a selected predetermined state. Initializing a training session consists of changing the simulation hardware and software components to a new configuration. Initialize is sometimes referred to as Return-to-Datastore. The predetermined state is created via the Datastore command.
Instructors	Personnel responsible for developing instructional materials and teaching crew, GSP, and ground-processing personnel the skills, knowledge, and attitudes necessary for ISS operation. Instructors control and monitor training sessions in the SSTF.
Instructor/Operator Station (IOS)	A workstation used for all real-time interactions with the SSTF. It can be used by an instructor to monitor and interact with a training session, including changing simulator parameters and introducing malfunctions. It can also be used by an operator to initialize, monitor, and control a training session.
Interface Agent	An interface agent is an Ada partition that either communicates with an asset or provides a low fidelity simulation of that asset when it is not available for inclusion in a training session.
International Standard Payload Rack (ISPR)	The basic structure used to contain payload experiments in the ISS U.S. Laboratory module.
Internet Protocol (IP)	The internet protocol suite layer that performs routing functions. It provides an unreliable, connectionless datagram delivery service.
Internet Protocol Suite (IPS)	A suite of protocols that allows heterogeneous computers to communicate with each other. It is commonly called the TCP/IP protocol suite.

Interprocess Communication (IPC)	The act of communicating between processes in which processes may be in the same computer or on different computers that are networked together. The IPC protocol referred to in this document is the Berkeley Software Distribution (BSD) sockets.
ISPR-Mounted Interface Panel (IIP)	A panel that is part of an integrated PTS. It provides a combination of operational and simulated ISS interfaces and simulation-unique connectors for electrical power and interfaces to the SSTF computers. The IIP provides connectors compatible with standard umbilicals to allow connection to the SIP and terminals to allow PTS connection.
Laboratory Support Equipment (LSE)	A set of standard laboratory devices shared by multiple users of ISS payload experiments on a noninterference basis.
Malfunction	A simulated deviation from the normally expected behavior of a core system or payload, usually initiated by the instructor as part of the training process.
Mode	The functional state of an integrated PTS. For convenience, certain activities are considered as modes. Possible PTS modes include Run, Freeze, Initialize, Datastore, Safestore, Return-to-Safestore, and Terminate.
Multiplexer/Demultiplexer (MDM)	Computers that control and manage Space Station onboard functions. Each MDM is configured for a specific C&DH task. The particular application software executing within the MDM determines its expertise.
Payload	The hardware, software, specimens, experiments, and other items provided by an ISS user for operation on board the ISS for scientific or commercial purposes.
Payload Agent	For the PTC system, either the CSIOP or SSTF. The CSIOP payload agent is an interface agent that communicates with the PTSs integrated into a training session. The SSTF payload agent communicates with the CSIOP payload agent for those PTSs that are online. When PTSs are not available, PRU data is used to simulate the nonavailable PTSs.
Payload Developer	The term used in the PUDG for the group of organization responsible for developing payloads. It includes the sponsoring NASA Payload Development Center (PDC), the Payload Element Developer (PED), and possibly other support groups and contractors.

Payload Ethernet	A hub and spoke Ethernet that simulated the ISS Payload Ethernet. It has connectors at each SSTF crew station element rack location and at some UOPs to allow data transfer among payloads and between payloads and PCSs attached at a UOP. It also allows medium rate data transfer to the PEHG.
Payload Ethernet Hub Gateway (PEHG)	The ISS system that functions as a hub for the payload Ethernet and also provides a gateway for medium rate payload data to be routed to the HRDL. It is attached as a remote terminal device on a C&DH 1553B bus to allow command and control. The SSTF includes a simulated PEHG which discards data addressed to the gateway function.
Payload Operations Integration Function (POIF)	A joint NASA Civil Service/Contractor team performing payload operations integration capability development, payload operations integration preparation and training, and real-time payload operations integration. POIF is administratively centered at MSFC and conducts operations from the POIC at the MSFC HOSC.
Payload Resource Utilization (PRU) Model	A surrogate model of a payload that may or may not have a corresponding integrated PTS. It provides a simplistic model of the payload that satisfies the minimum interface requirements for the SSTF core systems.
Payload Simulation Network (PSimNet)	The user-level protocol used to communicate between the PTSs integrated into a training session and the SSTF. It is designed to support real-time operations on a distributed architecture.
Payload Simulator Environment (PSE)	A low-cost PC-based simulation environment that supports rapid development of simulation models and includes the PSimNet and C&DH interfaces required for a PTS to be integrated into the SSTF.

Payload Simulator Requirement Document (PSRD)	A document written by POIF Simulation Engineering. It consists of two volumes: Volume I defines the payload-independent physical, functional, and interface requirements for the PTS necessary to support PTC training and identifies the basic training objectives and the approach used to develop the PTS. In conjunction with the PUDG, it identifies the parties responsible for integrating, verifying, operating, and maintaining the PTS. Volume II provides the payload-specific data and display parameters and inventory and checkout information for the PTS. It will also document the detailed payload-specific agreements between the POIF, the PD, and the SSTF PTC concerning the PTS.
Payload Training Capability (PTC)	Capabilities added to the SSTF to support payload training.
Payload Training Simulator (PTS)	A hardware and/or software representation of an ISS payload that is located in the ISPR rack location in the U.S. Lab. The more specific term *integrated PTS* applies to rack-level trainers that can be integrated into the SSTF PTC to be used to support flight crew and GSP training on payload operations.
Portable Computer System (PCS)	A computer that provides crew interfaces to payloads and ISS systems for commanding, monitoring, and visual annunciation. It also provides a crew interface to operate local COTS applications. The PCS can be connected to the C&DH 1553B bus or the PEHG Ethernet at a UOP.
Protocol	A set of rules that allows different computers and programs to communicate with each other.
Rack Mobility Unit (RMU)	A pallet that is attached under an SSTF ISPR at the SSTF to allow efficient handling of the SSTF ISPR, including positioning in a crew station element. It can accommodates two inflatable air bearings that can be inflated with a portable air pump to allow movement of the SSTF ISPR over a smooth surface.
Rack Shipping Container (RSC)	A shipping container specifically designed to be used to safely transport an SSTF ISPR. It can be disassembled for storage at a PD location.

Return to Safestore	A moding command that causes the training session to be initialized to the most previous datastore point in time and then to be updated with time-dependent data to the point in time that the safestore point reflects.
Run	A term that refers to both the moding command to go to Run and the state of being in Run. When the simulator is in Run, simulated time is in step with real time.
Safestore	A term that refers to both the moding command that causes predefined time-dependent data to be captured and stored on mass storage and to the collection of the time-dependent data.
Sammi	A COTS product of the Kinesix Corporation used to build and manage man-machine interfaces for the SSTF IOSs.
Secondary Lab (SLab)	A partial representation of the U.S. Lab flight element that supports ISS flight crew and GSP training on the operation of U.S.-sponsored payloads manifested in the U.S. Lab. It also supports POIC training sessions, SPTC sessions, and PTS integration and interface verification and test procedures.
Session Host Computer String	The systems that collectively provide the computational resources for the SSTF systems.
Signal Conversion Equipment (SCE)	Computer equipment that provides for analog and digital inputs and outputs. The PSE includes SCE for interfacing with PTS sensors and effectors. SSTF SCE provides interfaces for some simulation equipment to the SSTF computers.
Simulated Greenwich Mean Time (SGMT)	The simulated time that a training session is based on, as modeled in the SSTF. The SGMT value includes the year, day of year, and milliseconds from midnight. The SGMT value is distributed to SSTF computers and sent cyclically to each PTS integrated into a training session via the PSimNet. SGMT is frozen in Freeze mode and progresses at normal rate in Run mode. Performing a Return-to-Datastore resets SGMT to a new time and day.
Simulation Virtual Machine	A software executive layer running on top of a real-time operating system that provides distributed fine-grained message communication, rate-monotonic scheduling, and other capabilities in support of the real-time training simulation.

Simulator Test Fixture (STFx)	A PC-based system that supports verification and testing of integrated PTSs and is used for SPTC sessions. It provides limited fidelity models of SSTF core systems and the SSTF side of the PSimNet interface. It includes user interfaces and a scripting capability to control a PTS via the PSimNet and to control operation of a STEP.
Space Station Training Facility (SSTF)	A full-mission training complex. It is used to train crewmembers and GSP in the operation of the ISS and its payloads. The SSTF is located in JSC Building 5 South.
SSTF ISPR	The main supporting platform for PTSs in SSTF crew station elements. It meets the flight U.S. ISPR specifications for size and fit to support the mounting of flight-equivalent PTS hardware and flight-equivalent hardware panels. An SSTF ISPR can be obtained as described in Appendix IV, Section 40.4.
Standalone Payload Training Capability (SPTC)	An SSTF capability that provides for training using an integrated PTS independent of connections to the SSTF real-time session equipment. An SPTC session includes a PTS, an STFx and a STEP. The SPTC is also used for verification of a PTS prior to its integration into the SSTF.
Standoff-Mounted Interface Panel (SIP)	A panel located at each crew station facility rack position. The SIP provides a combination of operational and simulated ISS interfaces and simulation-unique connectors for electrical power and interfaces to the SSTF computers. It provides connectors compatible with standard umbilicals to allow connection to the IIP.
State	The state (not mode) of an integrated PTS. The SSTF has three states defined in the Software Architecture Standard: Pre-Session, Session Active, and Post-Session. A PTS is assumed to also have three states: Offline, Ready, and Session-Active. Offline parallels the SSTF Post-Session, in which the PTS is not ready to communicate with the SSTF. Ready is similar to the SSTF Pre-Session, in which the PTS is listening on the PSimNet for a connect message. Session-Active is the state in which the PTS is actively communicating with the CSIOP. Note that the CSIOP may still be in the Pre-Session state.

System Simulation	A software and/or hardware simulation that represents selected characteristics, functions, and behaviors of the ISS flight systems and the space environment necessary to support payload operations training.
Termination	The process by which a hardware or software component is disabled upon completion of its use. System simulator software termination occurs as a part of the session host computer string executive session termination. System simulator software termination may involve setting data to default, nominal values, and safing system simulator hardware. When termination is complete, the system simulator software must be initialized before it can be operated.
Time-Critical Message	Time-critical messages are those messages that quickly loose their value. An occasional loss may be detectable and annoying, but a lost message will not cause the training session to vary from its normal simulation fidelity. Time-critical messages are characterized by their cyclic nature.
Training Script	A preplanned sequence of events and/or activities that may or may not be timelined, supported by a set of conditions and values defining situations necessary to accomplish training goals. Training scripts are used to control and monitor activities and invoke malfunctions. A scripting tool exists to create training scripts.
Training Session	An activity and time interval that occurs on the SSTF dedicated to meeting specific flight crew and GSP training objectives. A training session begins at session host computer string initialization and lasts until the completion of session host computer string termination.
Transmission Control Protocol (TCP)	One of the two predominant transport layer protocols. It provides reliable end-to-end message delivery.
U.S. Laboratory Flight Element	The physical structure that accommodates payloads on board the ISS. It includes accommodations for ISPRs and LSE and provides interfaces for crew PCS.

U.S. Laboratory Trainer Module (Lab)	The physical structure that accommodates a spatially oriented increment load of payload simulators, system simulator hardware, and system rack silk screens and faceplates in order to simulate the interior environment of the U.S. Lab flight element to the maximum extent possible in an earth-gravity environment. The Lab accommodates the ISS flight crew during training sessions.
User Datagram Protocol (UDP)	One of the two predominant transport layer protocols. It provides an efficient, but unreliable, message delivery.
Word	A unit of data storage. Its size is determined by the architecture of the computer system and is generally either 16 or 32 bits. For this document, its size is considered to be 32 bits unless otherwise noted.
X-Windows/Motif	A popular graphical user interface running on top of the UNIX operation system.